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Cover

Jupiter and Its Satellites—In this dramatic photograph, one of thousands transmitted daily by Voyager 1, before and since its closest encounter with Jupiter in early March, the Great Red Spot and three of the immense planet's largest satellites are visible. The shiny black disk near the right border of Jupiter is Io, the innermost large satellite; outside the planet's perimeter at the right is the bright Europa: Callisto, the darkest of the satellites, is barely visible at lower left of photo. Photo was taken at a distance of 28.4 million kilometers from the planet.

Correction

Because of a typographical error on page 23, March *Activities,* the name "Hart" appeared as "Handy." Editorial apologies to Delores C. Hart, widely known as NASA's former Federal Women's Program Coordinator, now acting director of the Equal Opportunity Office.

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Table of Contents

Letter from Washington 3
NASA Names Four Shuttle Orbiters 6
Remote Sensing and the Private Sector 6
Americans and Canadians Study Eclipse 6
Encore for Tokyo Exposition 7
Civil Service Reform in 1979 9
Early Findings from Pioneer Venus 11
Pilot Program Covers Spacecraft Equipment Data 12
Electricity-Saving Device Gains Widespread Notice 12
New Method Discovered for Casting Incompatible Alloy Materials 12
Proposals Invited for Spaceport Program 13
High Honors to Ames Scientists 13
New York Students Plan Cargo for Shuttle 14
Students Investigate Careers in Aerospace Engineering 15
Voyager Views of the Jovian System 16
DoE Man Joins NASA 20
New Chief for International Affairs 20
Hinners Leaves NASA 20
Program Announced for International Meeting. 21
Improved Solar Cell Technology 22
Toastmasters Milestone 22
Black Group Praises JSC for Minority Effort .. 23
American Rocketry Leader Dies 24
Contractor News 24
Launches for 1979 25
Patents for Inventions 26
Another Dividend from Air and Space 28

Letter from Washington

Dear Colleagues:

During the FY 1980 budget hearings held in February by the Subcommittee on Science, Technology and Space of the Senate Committee on Commerce, Science and Transportation, one of the more interesting and articulate statements on the overall U.S. space program was made by the well-known American author, James A. Michener.

I would like to share with you part of his highly relevant and moving testimony.

"The only justification for allowing me to appear before your Committee is that for some years I have been studying the rise and fall of nations and in so doing have reached certain conclusions governing that process.

"There seem to be great tides which operate in the history of civilization, and nations are prudent if they estimate the force of those tides, their genesis and the extent to which they can be utilized. A nation which guesses wrong on all its estimates is apt to be in serious trouble if not on the brink of decline. Toward the middle of the Fifteenth Century the minds of sensible men were filled with speculations about the nature of their world, and although not much solid evidence was available, clever minds could piece together the fragments and achieve quite remarkable deductions.

"Prince Henry the Navigator of Portugal occupies a curious place in history. He never captained one of his ships; he never sailed on any voyage of exploration; in fact, he stayed at home devouring old books, new rumors and future guesses, and from this melange constructed a view of the world that was extraordinarily accurate, even though he died some thirty years before Portuguese explorers brought proof of his theories.

"Christopher Columbus had very little solid data to work with, but he had clever intuitions and a powerful capacity to piece together odd bits of information, leading him to conclusions that resulted in the effective discovery of America.

"Nations at that time faced problems comparable to those faced by individuals like Columbus, Vasco de Gama and Sebastian Cabot. They had to decide whether they wanted to participate in the exploration of the world, and if so to what degree of commitment. Those like Portugal and Spain, who made early and fast decisions, gained empires of fantastic richness. Others like disoriented Germany and Italy, who did not perceive the possibilities, suffered grave disadvantages and never caught up. England and France were very tardy, but in the end the first made a stunning recovery, the latter never did.

"I am not primarily interested in either the exploits of a few daring captains or the economic advantages of the nations they represented. The more lasting effect was on the spirit of the times, that wonderful enlarging of the human consciousness when it realized that the old definitions no longer applied, when it knew that the world consisted of a great deal more than Europe. To have missed the explorations was regrettable, but to have missed this spiritual awakening would have been disastrous. France and Sweden are excellent examples of nations which did little of the manual work but which reaped the intellectual rewards of the period. One might almost argue that Portugal and Spain dragged home the raw material for France and Sweden to codify and digest, proving that any nation can participate in the great swing of civilization according to its peculiar capabilities. Portugal provided daring sea captains. England provided able administrators. And France provided the philosophers. Those which provided nothing lost an entire cycle of historical experience from which they never fully recovered. . . .

"But history is a grand mix of concepts, actions, organizings and commitments which determines the extent to which any nation can achieve a good life for its citizens, and I believe without question that if a nation misses the great movements of its time it misses the foundations on which it can build for the future. . .

"Are there non-military advantages to be gained from a space program? The high technical requirements for success in space are so fundamental that spin-off rewards are almost automatic. Radio, television, medical instrumentation, miniaturizing, watches, new food processes, communications, health advances and improvement in clothing are some of the few advantages which I myself have gained because of the space program, and I am speaking

only of small items which can be comprehended and used by the individual.

"If one considers the larger items, like intercontinental communications satellites, the mapping of weather patterns, the analysis of soils and forests, the exploration for minerals including oil, the management of fisheries and the like, the potential rewards are multiplied many times.

"And the nature of human intelligence is such that no one today can even guess the limits of either the personal items or the industrial which might accrue from the basic scientific work that has to be done in a space program. I have followed our past space adventures about as carefully as an uninstructed layman could, and I have a rather imaginative mind, but I anticipated almost none of these significant by-products, and I doubt if any of us in this room today could predict where the next contributions will be made.

"I have heard one impressive argument against what I am saying now. A man of some probity said, 'If we had applied our scientific brains to these problems, we could have solved them all at one-tenth the cost.' He is right. Had the Congress twenty years ago set aside a substantial budget, and had it authorized the assembling of a body of top scientists, and had it provided them with spacious laboratories and told them, 'Devise a computerized navigational instrument that will operate regardless of where in space it is stationed,' this could surely have been done. But neither Congress nor the human mind works that way. It is only when great felt needs spur the imagination that certain accomplishments become possible. As a project by itself few of the bonuses cited above would have materialized; as part of a national effort with a clearly defined goal they all came into being, and others like them will follow.

"Are there military advantages to be gained from a space program? I would be terrified today if only Russian and Chinese vehicles were orbiting in space. Their military advantage would be so tremendous that we might almost suffer as a nation a kind of psychological shock from which we might never recover. For we would certainly be at their mercy.

"I fear that the potentials of space warfare have even yet not been impressed upon the American public. We do not realize the overwhelming advantage a nation would enjoy if it alone commandeered space, if it alone could direct by radio beam when and where an object or its cargo was to be brought down to Earth. Any nation which allowed its enemies such a superiority would be doomed.

"But if all nations have the capacity to utilize space defensively, then the peril is diminished and reasonable arrangements can be worked out. But only through parity can this be done.

"Therefore, the United States must have a sensible space program, whether it wants one or not. To fail to keep up with new developments in this field would be disastrous, and any administration which permitted a lag should be condemned. We must know what the capabilities of space are, and we must retain our proficiency in using them.

"I think we have done a fairly good job in this area so far, and I would suppose that from our strength we would be able to deal intelligently with those other nations who have attained or will attain a comparable capacity. This is the great unknown ocean of the universe and we in 1979 are as obligated to probe it and use it and participate in its control as the nations of Europe were obligated to explore their terrestrial oceans in 1479.

"The future and the safety of those nations depended upon their mastery of the seas; ours depends in shocking measure to our cautious control of space, and if we abandon it to others we condemn ourselves.

"Are there spiritual advantages to be gained from a space program? The spirit of man, and the resolve of a nation, are tenuous things, to be fortified by the strangest experiences or destroyed by the most unanticipated accidents. Outward events influence them but inner resolves usually determine outcomes. A novelist sees men and women destroy themselves because the will to survive has been lost; the historian watches nations go down because of fatal wrong choices which sap the national energy. Usually the tragedy occurs when inner convictions are lost, or when a sense of general frustration or waning purpose prevails.

"It is extremely difficult to keep a human life or the life of a nation moving forward with enough energy and commitment to lift it into the next cycle of experience. My own life has been spent chronicling the rise and fall of human systems, and I am convinced that we are all terribly vulnerable.

"I do not for a moment believe that the spiritual well-being of our nation depends primarily upon a successful space program. There are, as William James said, moral equivalents to war, moral substitutes for any charismatic national experience. I am sure we could, as a nation, attain great spiritual reassurance from rebuilding our cities or distributing our farm produce better. And my experience in the

arts has taught me to be suspicious of late fashions or high styles. Space programs are stylish today and run the risk of being abused.

"But I also believe that there are moments in history when challenges occur of such a compelling nature that to miss them is to miss the whole meaning of an epoch. Space is such a challenge. It is the kind of challenge William Shakespeare sensed nearly four hundred years ago when he wrote:

> There is a tide in the affairs of men,
> Which, taken at the flood, leads on to fortune;
> Omitted, all the voyage of their life
> Is bound in shallows and in miseries.
> On such a full sea are we now afloat,
> And we must take the current when it serves,
> Or lose our ventures.

"We risk great peril if we kill off this spirit of adventure, for we cannot predict how and in what seemingly unrelated fields it will manifest itself. A nation which loses its forward thrust is in danger, and one of the most effective ways to retain that thrust is to keep exploring possibilities. The sense of exploration is intimately bound up with human resolve, and for a nation to believe that it is still committed to forward motion is to ensure its continuance.

"I doubt if there is a woman or man in this room who honestly believes that the United States could ever fall backward, as other nations have within our lifetime. Intuitively we feel that we are exempt. Yet for us to think so is to fly in the face of all history, for many nations at their apex were inwardly doomed because their will power had begun to falter, and soon their vulnerability became evident to all. Enemies do not destroy nations; time and the loss of will brings them down.

"Therefore we should be most careful about retreating from the specific challenge of our age. We should be reluctant to turn our back upon the frontier of this epoch. Space is indifferent to what we do; it has no feeling, no design, no interest in whether we grapple with it or not. But we cannot be indifferent to space, because the grand slow march of our intelligence has brought us, in our generation, to a point from which we can explore and understand and utilize it. To turn back now would be to deny our history, our capabilities.

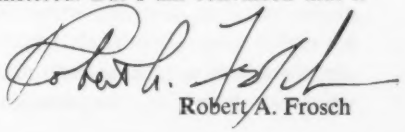
"Each era of history progresses to a point at which it is eligible to wrestle with the great problem of that period. For the ancient Greeks it was the organization of society; for the Romans it was the organization of empire; for the Medievalists the spelling out of their relationship to God; for the men of the Fifteenth and Sixteenth Centuries the mastery of the oceans; and for us it is the determination of how mankind can live in harmony on this finite globe while establishing relationships to infinite space.

"I was not overly impressed when men walked upon the Moon, because I knew it to be out there at a specific distance with specific characteristics, and I supposed that we had enough intelligence to devise the necessary machinery to get us there and back. But when we sent an unmanned object hurtling into distant space, and when it began sending back signals—a chain of numbers to be exact—which could be reassembled here on earth to provide us with a photograph of the surface of Mars, I was struck dumb with wonder. And when computers began adjusting the chain of numbers, augmenting some, diminishing others, so that the photographs became always more clear and defined, I realized that we could accomplish almost anything, there in the farthest reaches of space.

"My life changed completely on the day I saw those Mars photographs, for I had participated in that miracle. My tax dollars had helped pay for the project. The universities that I supported had provided the brains to arm the cameras. And the government that I helped nourish had organized the expedition. I saw the universe in a new light, and myself and my nation in a new set of responsibilities. My spirit was enlarged and my willingness to work on future projects fortified.

"No one can predict what aspect of space will invigorate a given individual, and there must have been millions of Americans who did not even know Mars had been photographed. But we do know that in previous periods when great explorations were made, they reverberated throughout society. Dante and Shakespeare and Milton responded to the events of their day. Scientists were urged to new discoveries. And nations modified their practices.

"All the thoughts of men are interlocked, and success in one area produces unforeseen successes in others. It is for this reason that a nation like ours is obligated to pursue its adventure in space. I am not competent to say how much money should be spent. I am not competent to advise on how the program should be administered. But I am convinced that it must be done."



Robert A. Frosch

NASA Names Four Shuttle Orbiters

The first four Space Shuttle orbiters to operate in space will be named after oceangoing vessels used in world exploration and discovery.

Orbiter 102, scheduled to be launched into Earth orbit late this year, is named *Columbia*. Subsequent orbiters will be named *Challenger* (Orbiter 099), *Discovery* (Orbiter 103) and *Atlantis* (Orbiter 104).

The first orbiter constructed (Orbiter 101) was named *Enterprise* in 1976 after the flagship in the popular television series "Star Trek." The original *Enterprise* was a sailing ship that took part in an important Arctic expedition between 1851 and 1854. *Enterprise,* which flew the Shuttle approach and landing tests in 1976, recently completed vibration tests at the Marshall Space Flight Center.

The pioneering ship *Challenger* made a prolonged oceanic exploration cruise from December 1872 to May 1876 gathering scientific data about the Atlantic and Pacific Oceans that filled 50 volumes. *Challenger* also was the name of the Apollo 17 lunar module that landed on the Moon in December 1972.

The sea-going *Columbia,* out of Boston, entered and explored the mouth of the Columbia River in 1792. Captain Robert Gray named the river after his sloop. *Columbia* also was the name of one of the first U.S. Navy ships to circumnavigate the globe and it was the name of the Apollo 11 command module that circled the Moon during the first manned landing on the lunar surface, July 20, 1969.

Discovery was used to explore Hudson Bay in Canada and to search for a northwest passage from the Atlantic to the Pacific in 1610 and 1611. The name also was given to one of two ships used in the 1770s to discover the Hawaiian Islands and explore the coasts of southern Alaska and western Canada.

The two-masted ketch *Atlantis* logged half a million miles between 1930 and 1966 as the first American-operated vessel designed especially for ocean research.

Remote Sensing and the Private Sector

NASA and NOAA (National Oceanic and Atmospheric Administration, Department of Commerce) are undertaking a joint study scheduled for completion this summer to determine the extent to which private industry can participate more directly in the nation's civil remote sensing program. The study is one of several actions directed by President Carter in his civil space policy statement.

Remote sensing involves obtaining information about the Earth from space through use of various advanced sensing instruments. The private sector is being asked to submit views regarding increased participation in remote sensing in the immediate future.

Suggestions and opinions received will be considered in the development of plans and policies for private investment and participation in every aspect of remote sensing. Under consideration are many subjects related to all aspects of remote sensing, including: capital investment; system ownership; systems concepts; commercial product development; market assessments; incentives needed to participate; and the roles of government and the private sector.

The study is being directed by Arnold Frutkin, NASA Associate Administrator for External Relations, and Wilbur H. Eskite, Jr., NOAA Special Assistant for Studies and Analysis.

Submissions from the private organizations should be sent to the Director of Government/Industry Affairs, NASA, Washington, D.C. 20546. (Telephone: 202/755–3940.)

Americans and Canadians Study Eclipse

Four organizations in the United States and Canada joined on a sounding rocket program centered in Canada to study effects on the atmosphere and ionosphere of February's total solar eclipse.

Partial across the rest of the nation, the Feb. 26 eclipse was visible in its totality only in the northwestern U.S. and Canada. The total eclipse will be the last one observable from the North American continent in this century. It began at dawn over the Pacific Ocean, west of Puget Sound, and terminated at sunset over northern Greenland.

In percent of totality, the eclipse ranged from 100 percent in the U.S. northwest to a maximum of 31.5 in Miami. The maximum percentages for other cities were: New York 60.8, Dallas 66.6, St. Louis 74.7, San Francisco 86.4, San Diego 74.1, Phoenix 75.3, Memphis 66.4, Chicago 79.3, Denver 87.5, Atlanta 56.7 Duluth, Minn., 93.1 and Juneau Alaska 85.9.

The participating organizations in the sounding rocket eclipse study are NASA, the Army's Atmospheric Science Laboratory (ASL), the Air Force Geophysics Laboratory (AFGL) and the

National Research Council of Canada (NRC). Research objectives are to produce improved models with which to predict atmospheric responses under a variety of disturbances.

Two rocket launching and tracking sites were involved, both located in western Ontario, Canada, about 800 kilometers north of Minneapolis. The NRC and the ASL small rocket site is at Cochenour and the NASA/ASL major rocket site is on the Chukuni River. The closeness of the sites allows for the maintenance of positive safety controls and the sharing of support facilities.

NASA acted as the U.S. government's lead agency for the western Ontario eclipse activities. NRC supported the U.S. program, providing construction, ground and flight safety, support, launch coordination and other launch site support as required on a reimbursable basis.

The Wallops Flight Center supported seven launches during the operation: three payloads with joint experiments for the University of Illinois and the University of Bern, Switzerland; one payload with experiments for Cornell University and the Naval Research Laboratory; one payload for the University of Pittsburgh; and two payloads for Pennsylvania State University.

Site preparation in Canada began last June and the launchers were installed in September. The Wallops center mobile range equipment at the launch site included: three radar vans, two telemetry vans, five sounding rocket launchers and miscellaneous vans and equipment to support launchings, tracking and data acquisition. Also transported to the site was a mobile power van to supply electric power for the entire Chukuni complex. The other site used commercial power.

About 70 Wallops employees and other U.S. personnel participating in the field operation stayed in the Red Lake area, a cluster of gold-mining communities (Red Lake, Balmertown, Cochenour, McKenzie Island Madsen) with a population of about 5,000. Most of the mines are inactive now, but between 1930 and 1972 produced more than $300 billion worth of gold.

Twelve U.S. satellites provided measurements for use in interpreting the eclipse experiments—GOES-2, GOES-C, Nimbus 4, Nimbus 6, Nimbus 7, SMS-1, SMS-2, SOLRAD 11B, Atmospheric Explorer-E, NOAA-5, Tiros-N and UK-5. On the ground, the ASL sponsored a partial reflection experiment for measuring electron densities and the AFGL sponsored mobile observatory for measuring infrared radiation from the high atmosphere. The National Science Foundation coordinated numerous other eclipse studies at widely-scattered locations.

The sounding rocket launches (a total of 15, with all but two being launched on eclipse day) from the two Canadian sites attracted a large number of people to the area. They viewed the proceedings from an NRC site near the Chukuni rocket launch area.

Encore for Tokyo Exposition

The Space Science Exposition, which opened last July 16 in Tokyo for a six-month season, was so well received that it re-opened in March for another season. Billed by its sponsors as the "greatest display of space hardware outside the U.S.," the exposition had a paid attendance of 5,514,658. Beforehand, the sponsoring Japan Science Society and Japan Maritime Shipbuilding Foundation had set an attendance goal of 3.5 million.

NASA and the Smithsonian's National Air and Space Museum (NASM) played major roles in the success of the Exposition. The artifacts, exhibits, photos and other information came primarily from those two organizations. In addition, several aerospace contractors and other U.S. museums lent items or built them for display. Most NASA centers are represented by items on loan.

The exposition is located on reclaimed land in Tokyo harbor, adjacent to the grounds of the permanent Museum of Maritime Science. The museum, a concrete structure built in the shape of a ship, is in itself a unique landmark. During the exposition, the museum houses a display of lunar samples and a collection of meteorites from the U.S. and Japan. A three-story exterior escalator was specially built to handle crowds viewing the lunar samples and extra-terrestrial specimens.

All the other buildings on the grounds, erected specifically for the exposition, include an Imax theatre, with a screen measuring 23 × 31 meters on which the NASM premier film "To Fly" is shown—with a Japanese sound track, of course. A Japanese pavilion contains models and the actual hardware of satellites, launchers, instrumentation, and other information from the National Space Development Agency (NASDA) Japan's counterpart to NASA.

The U.S. pavilion, designed by a New York firm, features a hall of history; actual Mercury, Gemini,

and Apollo spacecraft, engines, and suits; mockups of the lunar module crew stations, a full-scale cutaway of Skylab, a 39 percent wind-tunnel model of the Shuttle orbiter, a full-scale ATS-6 and Viking lander, and other scale models, graphics, and TV taped presentations. A Viking orbiter and a few other objects will be added for the new season. An actual Saturn I-B complete with Apollo command module is on display outdoors, with a Mercury-Redstone, Mercury-Atlas, and a Japanese launch vehicle. The grounds also contain food and souvenir shops, administrative offices, and an outdoor entertainment area for ceremonies, bands, and performing groups.

Export of the Saturn vehicle cost was underwritten entirely by the non-profit Japanese Association for the Space Science Exposition (ASSE). Except for ordinary in-house assistance, such as that which is provided ordinarily for such activities, there is no cost to NASA, NASM or any other U.S. organization. As a matter of fact, cost of vertically re-emplacing the Saturn I-B upon its return to the Kennedy center is being borne by the same organization.

Perhaps the centerpiece of the exposition is the Apollo theatre, its inverted cone-shape somewhat reminiscent of a Gemini spacecraft. Inside the building, up to 1,500 people stand on terraces surrounding the simulated lunar surface which dominates the center of the floor. The theater darkens, and eight large overhead screens circling the walls transport the audience to the Kennedy center in July 1969. NASA documentary film footage and sound track recreate the preparations and launch of Apollo 11. Soon a film screen in the ceiling is also activated, and the lunar voyage seems to be three-dimensional. As the story unfolds, the audience is looking up at the bottom of the lunar module, coming closer and closer. Just as the screen is filled, it breaks and slides open, and a full-scale lunar module (a Grumman mock-up) descends through it and gently touches down on the lunar surface. The voices of Neil Armstrong and Capcom can be heard under the Japanese commentary. Two astronauts, Japanese actors, climb down the ladder, "explore" the lunar surface, plant the U.S. flag, and re-enter the module. On cue, the ascent stage lifts off and "flies" up into the ceiling. The sturdy elevator cabling goes unnoticed in the drama of the 17 minutes it takes to remind audiences of all nationalities of one of their grandest accomplishments.

Sub-title of the exposition is "Space—Dream and Hope of Mankind," and it is oriented toward youth. The prime mover behind this major effort is Ryoichi Sasakawa, President of ASSE and a number of other membership organizations. The exposition has had the support of several government ministries. Its popularity and quality have now led to official participation by the Government of Japan, and the exposition's second season is designated officially as part of the UN International Year of the Child.

The enormous popularity of the exposition among the Japanese is well illustrated by the following quotations from a letter written to NASA's Mike Donahoe (Educational Programs at the Ames center) by Carmelite Father Mark Yamamoto:

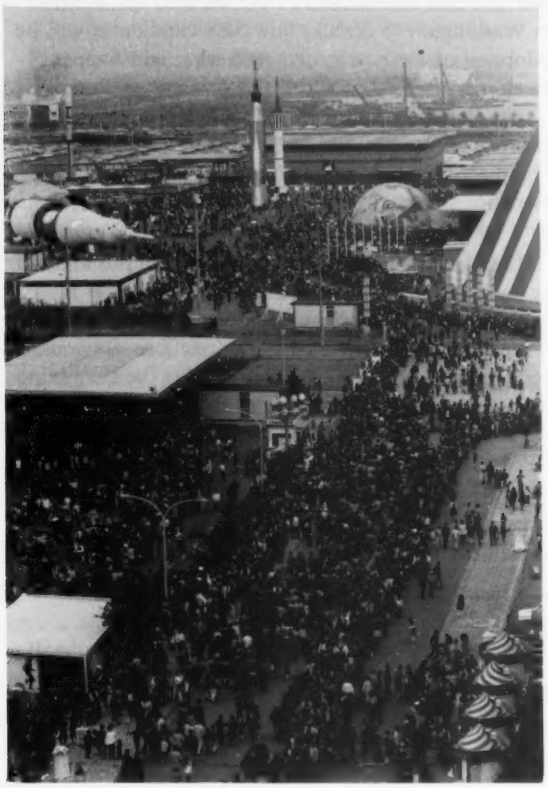
"I marvelled the variety of the people who came to see. Apparently they were of different ages, of every walk of life, of both sexes; large group of school boys, couples, family groups, young and old. I imagine the composition was quite similar to that of the crowd gathered at Cape Kennedy to witness the historical Apollo 11 moon shot.

"Beside several girls chattering excitedly, an engineer is examining a rocket engine from every angle forgetting the time and nodding to himself. While a school boy is taking notes and copying from explanation panels, a venerable hoary gentleman is silently contemplating the technological marvels before him. And thousands of clicks all around! None can tell how many photos are taken by the camera-addicted Japanese visitors.

"After nine years from the first Moon landing, the sheer presence of an apparently commonplace piece of gray rock is still capable of arousing a surge of vivid interest and enthusiasm. The impact this Space Expo gave is enormous, I dare say. The space exploration in itself has this common and strong appeal to human spirits, but people now began to understand its relationship with our everyday life and future well-being on this fragile blue gem.

"As for me, well, it's difficult to tell you my impression as a whole, It was of extreme interest for me to see so many of the real hardwares of space science. Even the 'smallest' of the exhibited rockets on the open square, the Redstone missile for suborbital tests, was quite impressive. The thought of being hurled up 100 miles from the surface penned in atop this rocket as it goes up balancing itself on the billowing flame is awe-inspiring. I do admire the courage of the first astronauts.

"Other objects, especially Gemini and Apollo capsules were very interesting. The scorched heat-shield alone is elegant enough to remind people of the thrilling final phase of the mission."



Tokyo Exhibit Enthusiastically Received—Japanese by the millions visited the Space Science Exposition held last year. Most of the displays came from NASA and the National Air and Space Museum.

Civil Service Reform in 1979

This is the first in a series of explanatory articles dealing with new systems established for Federal employment as a result of the recent government reorganization.

The enactment of the Civil Service Reform Act (CSRA) of 1978 causes significant changes in the administration of the Federal Civil Service. One part of the reform resulted in the disbandment of the U.S. Civil Service Commission and the transfer of its functions to four separate organizations, three of them new and the fourth already established. These consist of:

Office of Personnel Management—In charge of executive operations, investigations, personnel programs (functions involving program implementation and evaluation, and applicant examining). OPM also will administer the retirement and insurance programs and exercise management leadership in labor relations and affirmative action matters.

Merit Systems Protection Board—An independent agency responsible for safeguarding the merit system and individual employees against abuses and unfair personnel actions. The MSPB will hear and decide on employees' appeals, and will order corrective and disciplinary actions against an employee or agency when appropriate. The MSPB abolishes the Federal Employees Appeals Review Board.

Federal Labor Relations Authority—Oversees the creation of bargaining units, supervises elections, and deals with labor-management issues in Federal agencies. It replaces the Federal Labor Relations Council.

The Equal Employment Opportunity Commission—Continues to give leadership to, and enforces the provisions of, the Civil Rights Act as it affects the Federal work force; also hears and resolves certain discrimination complaints.

Not only does the Act reorganize Federal Personnel agencies, its provisions cover other functions of civil service, such as:

- the establishment in law of the principles of selection and treatment of employees from all segments of society on the basis of merit; identification of prohibited reasons for taking personnel actions such as discrimination or political activity;
- the requirement that agencies develop and use new systems for appraising employee performance;
- the setting of new disciplinary procedures and appeal systems;
- the provision of a variety of new authorities to increase flexibilities for employment and volunteer service and the addition of controls on the numbers of Federal employees;
- the establishment of the Senior Executive Service (covering supervisors and managers in grades GS-16 through GS-18 and most NASA "excepted" positions), which consists of a new pay personnel system for executives;
- the creation of a new merit pay system for supervisors and managers in grades GS-13 through GS-15, in which pay raises become less automatic, less tied to specific percentage amounts, and more related to job performance;

- the authorization of research and demonstration projects to test new approaches to personnel management;
- the expansion of intergovernmental personnel programs to increase the mobility exchange provisions and thus cover more types of organizations and people.

NASA has approached the carrying out of the reforms by first identifying which elements were most important to personnel management and in need of immediate action, then calling on management from staff and line organizations to develop and set in motion the necessary programs.

A Reform Steering Group of top managers was formed to oversee all reform activities within NASA. Three task groups report to the steering group—one concerned with the Senior Executive Service (SES), one with Performance Appraisal and Merit Pay, and one with Delegation of Authorities. (The accompanying chart shows the NASA plan that was adopted.) The groups presently are working on a series of assignments.

SES is chaired by Ed Kilgore of the Langley Research Center. It has identified, with the cooperation of various installations, the positions in NASA that should be in the SES. (NASA was the first major government agency to submit its request for positions to the Office of Personnel Management.) After notification by OPM as to the number of SES positions allocated, the NASA task group will convene SES coordinators from all field installations in Washington to discuss how SES candidates will be informed of the new system and what will happen when it is implemented.

The Performance Appraisal and Merit Pay task group is chaired by Bill Mecca of the Goddard Space Flight Center. It has completed organizational activities and is engaged in collecting and analyzing data on which to base recommendations.

The Delegation of Authorities task group is chaired by Jack Lister of the Johnson Space Center. It is developing the NASA position concerning whether it is practical at NASA to delegate functions previously performed by the CSC in areas such as the examining of new applicants for employment and approvals of certain pay setting and personnel actions without OPM involvement.

NASA was cited recently by OPM as having the most effective organization and plan for CSRA implementation among the larger Federal agencies.

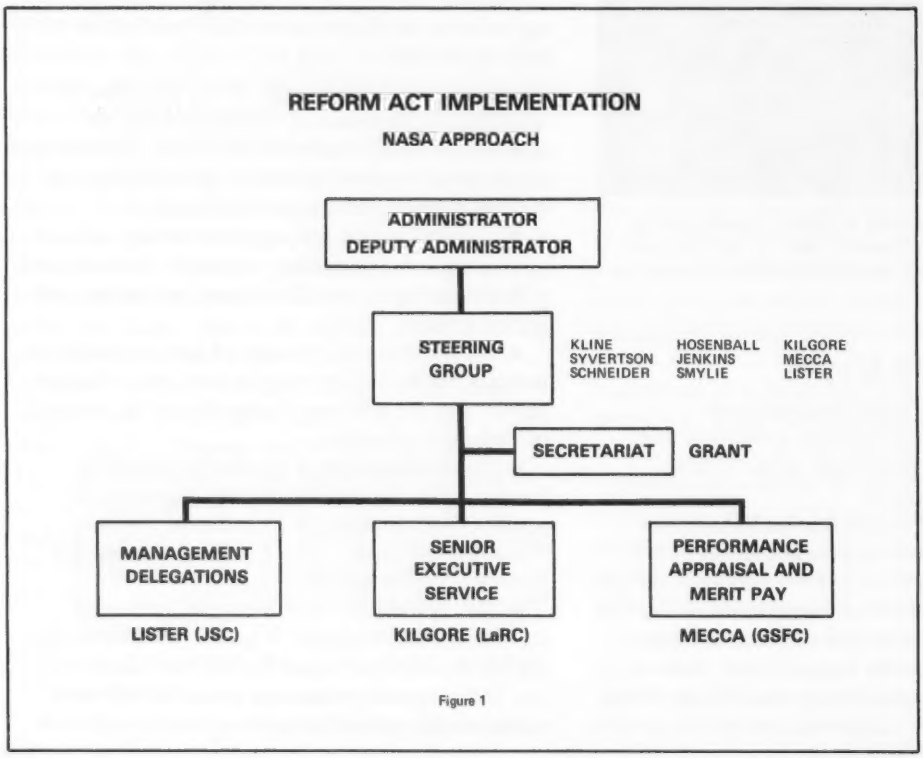


Figure 1

Early Findings from Pioneer Venus

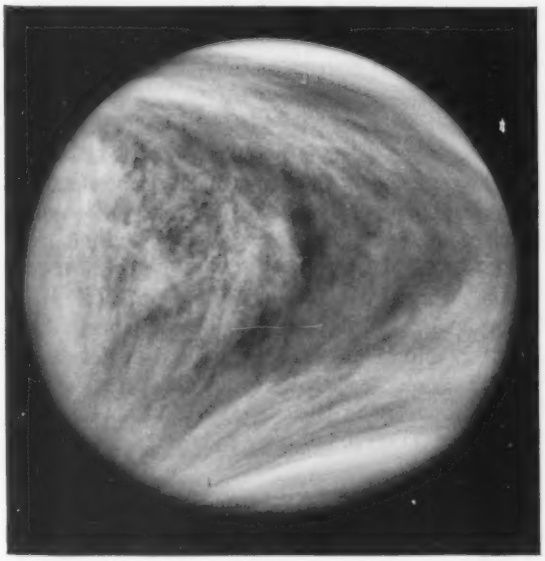
Early scientific findings by Pioneer Venus 1 and 2 include new information on the formation of the inner planets, an explanation for the superheated atmosphere and surface on Venus, and observation of "mysterious chemical fires" on the planet's surface.

Pioneer Venus 1, an orbiter, and the five atmospheric probes that make up Pioneer Venus 2, reached cloud-covered Venus last Dec. 5 and 9. The instrument-laden probes descended through the Venusian atmosphere to the surface, while the orbiter began an eight-month orbit of the planet, making measurements and taking pictures.

Although much more analysis is needed, early Pioneer findings seem to be providing new information about the formative years of the inner planets, Mercury, Venus, Earth, and Mars—and at what period the Sun ignited during these building processes. Pioneer results also suggest that the atmosphere on Venus circulates in large-scale global motions.

Other major findings reveal that:

- The planet's searing atmosphere and surface heat now seem quite certainly to be due to a "runaway greenhouse effect."
- Its clouds appear three well-defined, distinct layers, and seem to result from a vigorous cycle of sulfur-hydrogen-oxygen reactions. Spacecraft instruments also found that the clouds are composed mostly of oxygen, water vapor and sulfur dioxide.
- Data from the orbiter's first radar map suggest that the topography of Venus could be similar to Earth's, with high mountain-like features and extensive relatively flat areas. The Pioneer day probe also showed the presence of fine dust on the surface at its landing site in the southern hemisphere. This dust took about three minutes to settle after impact of the 90-kilogram probe at 35 kilometers per hour. The day probe survived for 67 minutes after landing.
- Starting at 13 km altitude, the two night-side probes saw an unexpected glow that increased as the probes descended. Mass spectrometer evidence for various sulfur compounds near the surface suggests that the mysterious glow could come from "chemical fires" on the surface or in the very hot and dense lower atmosphere near the surface. The "fires" would be fueled by reactions involving the sulfur compounds. Experimenters are considering another possibility—that the glow resulted from the heated or electrically charged surfaces of the probe craft themselves.
- The solar wind interacts with the Venusian atmosphere several times more strongly than expected. Unlike solar wind interaction on Earth, three key upper atmosphere regions seemed almost to coincide. They are the turbopause, where atmospheric mixing begins; the region of maximum ion density; and the base of the exosphere (the region where gases escape the planet to space).
- The Pioneer Venus spacecraft thus far have identified 10 chemical constituents of the atmosphere and 10 ions in the ionosphere of Venus.
- Composition of the planet's atmosphere appears to be: about 97 percent carbon dioxide, 1–3 percent nitrogen, 250 parts per million (ppm), helium, 6–250 ppm neon, and 20–200 ppm argon. Other constituents measured below the cloud layer were water vapor 0.1 to 0.4 percent, sulfur dioxide 240 ppm, and oxygen 60 ppm. There is indirect evidence that sulfuric acid and elemental sulfur particles also are found in the clouds. Further analysis of the data is expected to reveal additional sulfur compounds and other constituents.



Space History Is Made—First full disc photo of Venus ever seen was taken by Pioneer Venus satellite.

Pilot Program Covers Spacecraft Equipment Data

Manufacturers of spacecraft equipment have been invited to participate in a one-year NASA pilot program to formulate a computer data bank of available flight-qualified equipment and flight-qualifiable equipment.

Objective of the program is to provide NASA headquarters and field installations, the aerospace industry and the academic community with an up-to-date listing of such equipment. The information will be provided free of charge this year to users through a time-sharing computer system with access via local terminals.

The list will cover two classes of equipment: (1) items launched or flight-qualified within the last two years; and (2) items considered to be flight-qualifiable because they are under contract for design, development or manufacture with a projected launch date.

An item is considered flight-qualified if it has successfully passed all U.S. government or commercial customer-specified qualification tests for intended missions. A commercial customer is an organization procuring satellite systems or subsystems from the manufacturer.

A current listing of NASA standard equipment has been established on an information services network time-sharing system. As a supplement to the standard equipment listing, the NASA headquarters office of the chief engineer, systems engineering division, embarked on the one-year program in December to test the utility of a similar listing for available flight-qualified and flight-qualifiable equipment.

Further information may be obtained by contacting NASA Headquarters, Office of the Chief Engineer, Systems Engineering Division (Code DL-2), Washington, D.C. 20546, area code 202, 755–3040.

Electricity-Saving Device Gains Widespread Notice

Ten companies have been licensed to manufacture a revolutionary product invented by a NASA engineer, which has the ability to reduce dramatically the amount of energy consumed by the billions of electric motors in daily use throughout the United States.

The device, called a Power Factor Controller, was invented by Frank J. Nola, an employe at the Marshall Space Flight Center as he was seeking a way to reduce the amount of power necessary for operating solar heating and cooling systems. Since the invention was announced, more than 4,500 inquiries have been received, many from foreign countries.

Three of the licensees have reported that they are ready to accept orders. One of them has advertised the device for $13.60 and another has estimated that it could incorporate the device in a ½-horsepower motor for as little as $5.

The controller determines continuously the precise amount of electricity needed by a motor to which it is attached, to perform its work efficiently. It does this by sensing shifts in the relationship between voltage and current as the motor's workload changes.

A test recently was conducted by a private firm on an industrial sewing machine, one of about 3,500 used by the firm, which was operated by a ½-hp three-phase motor. The test motor used 33 percent less power than an identical motor without the device.

In tests conducted at the Marshall center on typewriters equipped with the controller, power savings of 20 to 40 percent resulted.

The Marshall center issued a request for proposals inviting industry to bid for marketing rights and participation in a cost-sharing development program. This type of cost-sharing contract is one method NASA uses to make space technology available for wide public application.

New Method Discovered for Casting Incompatible Alloy Materials

An electrical wire that offers little or no resistance to current is one of hundreds of beneficial projects that may be made possible by a new method of alloy casting discovered by metallurgists at the Marshall Space Flight Center.

Dr. Mary Helen Johnston and Richard A. Parr of Marshall's materials and processes laboratory, say that the new casting method is a result of research with materials that do not mix naturally.

"An example," Johnston said, "is lead and aluminum. Such products as superconductive wire, bearings and improved magnets could be made from an aluminum-lead alloy. These two materials can be mixed in a molten state but as they begin to cool and solidify, the aluminum and lead will separate."

There are several hundred possibilities for using the new process to control the structure of unmixable materials during casting, according to Johnston. "It

could open up a whole new range of alloys that we have never been able to produce before," she said.

The controlled structure is achieved by adding a small amount of impurities to the alloy materials during the melting process and applying a rapid cooling from one end of the cast. In aluminum and lead castings, the impurities cause the aluminum to form a hexagonal cell structure as it cools and the lead finds its way into the little valleys formed by the hexagons. These tiny particles of lead are trapped in the valleys and become uniformly dispersed throughout the casting.

"This is a breakthrough of major technical significance," said Robert Schwinghamer, director of the materials and processes laboratory. "Based on our research to date," he went on, "it seems that the method is generally applicable, is economical to apply, and can be used to produce particles of the secondary alloy material in the shape of spheres or rods, with controlled size and spacing."

Johnston believes that the implications of this breakthrough extend far beyond the possibility of producing novel composites for structural application. She said: "There are hundreds of alloy systems with liquid miscibility gaps about which little is known because metallurgists have traditionally been unable to render them in useful form. Many of the alloys will have unique and desirable electrical characteristics.

"There are so many possibilities," Johnston concluded, "that our problem now is choosing the way to go from here."

Proposals Invited for Spaceport Program

A prospectus soliciting proposals to manage and operate the public visitors program at the Kennedy Space Center was released by NASA on Jan. 25. A proposal conference to acquaint potential concessioners with the requirements and with the center was held at KSC in February. Proposals to meet the terms of the solicitation are due by May 15, 1979.

As a result of the prospectus, NASA expects to enter into a concession agreement covering a 10-year period, to begin May 1, 1980.

The Kennedy center, NASA's principal east coast launch base, is Florida's fourth most popular tourist destination as well. More than 1.6 million people visited in 1978 and a large percentage of them—some 1.3 million—took guided bus tours of the center and the adjacent Cape Canaveral Air Force Station.

The visitors center consists of two major buildings that house a wide variety of dynamic and static exhibits on space exploration, motion picture theaters and a bus terminal; a modern food services center; and exterior displays of full-scale rockets and spacecraft.

The successful proposer will be required to make a substantial initial investment, beginning with a fleet of buses to transport visitors along a tour route that includes historical landmarks and operational launch facilities for the Space Shuttle, as well as conventional rockets.

The proposals also will include offers for financing new buildings and facilities to enhance the NASA visitors program. NASA will provide some facilities, property and services for the concessioner's use, but the visitors program otherwise must be financially self-supporting.

The concessioner is to be granted the right to conduct such revenue-producing activities as the sale of food, souvenirs and bus-tour tickets, but also is required to provide some non-revenue creating services in support of the program and to pay concession expenses.

The visitors program is now operated by TWA Services, Inc.

The solicitations have been mailed to about 50 companies involved in tourism, recreation, park management and related fields. Companies not receiving the notice may obtain copies by writing J. E. Massey, AP-PRO-44, Kennedy Space Center, Fla. 32899 (area code 305–867–7356) and requesting Prospectus #10–9–0016–4.

High Honors to Ames Scientists

Dr. Robert T. Jones, Senior Scientist at NASA's Ames Research Center, was elected by the Fellows of the American Institute of Aeronautics and Astronautics to the status of Honorary Fellow.

Co-honorees this year are Simon Ramo, former vice-chairman of the board of TRW, Inc., and Alexander H. Flax, president of the Institute for Defense Analyses. Other Ames scientists previously named as Honorary Fellows include former center directors Smith J. DeFrance and Dr. H. Julian Allen.

Jones' citation notes his "many contributions, both theoretical and practical, to the design of high speed aircraft." Among his many accomplishments is the development in 1945 of the swept wing, now common on most commercial and military high speed aircraft.

Jones began his career in 1921 when he joined the Nicholas-Beasley Airplane Company and participated in the design and development of a three-passenger aircraft. A small 322 km/h racing plane of his design competed in the 1930 National Air Races. He subsequently pursued studies of mathematics and fluid mechanics under Dr. Max M. Munk, taking graduate evening courses at the Catholic University of America. In 1934 he joined the National Advisory Committee for Aeronatics. Three years later he became head of the Stability Analysis Section at NACA's Langley Field Laboratory.

Another of his well-known contributions is the theory of slender airfoils, which is applicable at both subsonic and supersonic speeds. He has published some 64 papers and one book; taught supersonic aerodynamics at Stanford University (1946–55); been an invited lecturer on more than 30 occasions. A Fellow of the American Institute of Aeronautics and Astronautics, he also is a member of the American Physical Society, and has served on the NASA subcommittees on fluid mechanics and astronomy. In 1973 he was elected to the American Academy of Arts and Sciences and to the National Academy of Engineering.

At the same time, the AIAA elected as a Fellow Dr. Leonard Roberts, director of the Ames center's aeronautics and flight systems unit.

The rank of "Fellow" is a mark of recognition given to Roberts for "the wide range and high quality of his contributions in guiding aeronautical research for the advancement of civil and military aircraft in aerodynamics, gudance, stability and control, simulator technology, and for contributions to national policy through his leadership of the 'Outlook for Aeronautics' study."

After receiving a Ph.D from the University of Manchester in 1955, Roberts joined NASA's Langley Research Center in 1957 as a researcher in aerodynamics and atmospheric and came to the Ames center in 1966.

Ames scientists and engineers presently holding the rank include Dr. D. R. Chapman, Jones (see above), Harvard Lomax and C. A. Syvertson. Russell G. Robinson, now retired from Ames, also is a Fellow. Former Ames employees who have been named Fellows are Dr. Hans Mark, Dr. A. J. Eggers, Dr. Harry J. Goett, Dr. J. R. Spreiter, Dr. W. G. Vincenti, W. E. Gasich and J. N. Nielsen.

New York Students Plan Cargo for Shuttle

The following article appeared in the February issue of the NEF OUTLOOK, *published by the National Energy Foundation in New York City.*

This is the story of what at first appears to be an unlikely marriage: space science and a school in New York City's upper Manhattan borough.

The students of School District 6 in Manhattan have been proving that the two are far from being mutually exclusive. They are about to embark on a unique and innovative project that will involve them directly in a space adventure—called a "Getaway Special."

Guided by their project director, Dr. Lloyd Makarowitz, students are planning to develop a scientific experiment, whose nature is now being explored, for flight aboard the Space Shuttle. The district has already placed a deposit on a reservation for five cubic feet aboard a Shuttle flight, an area that will house the experimental package.

The district was visited last year by NASA's Astronaut Candidate Frederick D. Gregory. Gregory and District 6 students appeared on several major television programs during his visit.

Students in the district now are learning space science through a special series of lessons, in preparation for the adventure that awaits them. A contest will be held soon to name the project, with the winning student receiving a model of the Space Shuttle donated by NASA. Space is available aboard the Shuttle to individuals and organizations in both the private and public sectors. The cost of the service is relatively modest, and the only major criterion is that the space be occupied by a serious effort at scientific research and development.

School District 6 is taking advantage of the unique opportunity to provide them with first-hand experience in space science. After preparing the experimental package, the students will have the thrill of seeing it sent into space. When it returns, they will make analyses, evaluate the results, of their experiment and report the results to their community and the world.

Commenting on the project and its effect upon both teachers and students, Dr. James Roberts, deputy

superintendent of District 6, noted the cooperation provided by NASA in furnishing materials, lecture demonstrations and workshops. He said:

"The . . . resounding success of our District Science Fair, which was judged by Maj. Gregory, produced an unusual number of entries in the Student Exposition on Energy Resources, an annual activity of the National Energy Foundation. An astounding number of first-place honors afforded our children the opportunity to visit a number of interesting places. The effect of this type of recognition on our student body has been profound, and has evoked great improvement in student attitudes."

Working toward an Experiment in Space—Deputy Superintendent Dr. James Roberts (School District 6, New York City) stands with the group of students involved in assembling a "Getaway Special" to be sent into space by NASA's Space Shuttle.

Students Investigate Careers in Aerospace Engineering

Camden City high school students working on the design and development of a scientific experiment to be placed aboard NASA's Space Shuttle orbiter recently investigated careers in aerospace engineering during a visit to RCA's Astro-Electronics activity at Princeton, N.J.

The students are participating in Orbit '81, an unusual educational program sponsored by RCA, which involves inner-city high school students in the creation of an experiment expected to leave Earth on the Shuttle in 1981. Although other high schools are conducting similar programs, NASA officials say that the Camden project is unique because it is the only "total involvement program covering all of the disciplines, arts and skills" taught in the curriculum.

During their day-long visit to the space center, the students heard engineers and technicians describe the work being done in the exploration of the space frontier. A tour of the Princeton complex helped acquaint the group with Earth satellites, space vehicles and associated ground equipment.

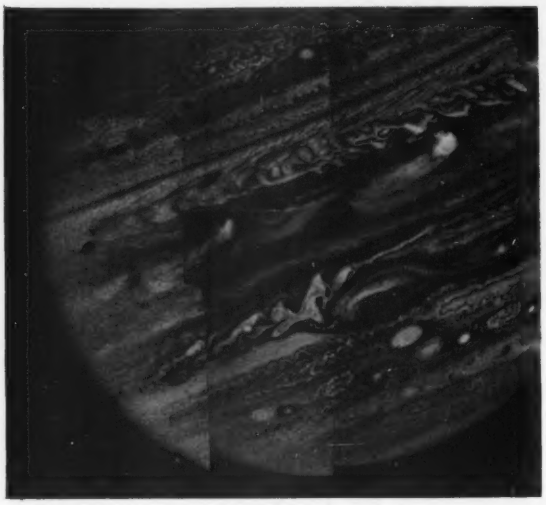
The student visitors, from Camden and Woodrow Wilson high schools in New Jersey, met with several engineers in small groups to discuss the requirements and rewards of the aerospace engineering field. The aim of the Orbit '81 program is to familiarize students with careers in science, including engineering, of which they may not be aware.

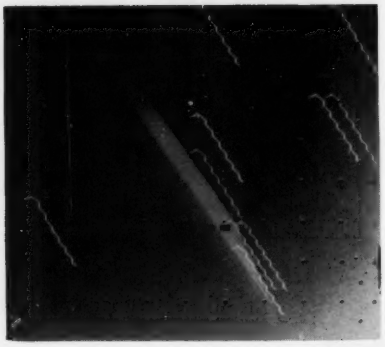
The Camden space project is part of NASA's "Getaway Special" program, which accepts suitable experiments from any individual or organization from any nation that will elicit new information contributing to scientific knowledge. Typical experiments could be solar studies, chemical phenomena in space environments, or Earth resources. The Orbit '81 experiment will be created and built by the Camden students with the assistance of RCA engineers and technicians. Assistance also is offered by NASA, the Federal Aviation Administation and officials of the New Jersey Educational Improvement Center.

Visiting Space Center—In Princeton, N.J., students from Woodrow Wilson and Camden high schools are shown a thermal-vacuum testing chamber by Dr. Al Sheffler (center). The student group is working on Orbit '81, an education program to design and develop a scientific experiment to be placed aboard NASA's Space Shuttle orbiter. During the visit, they met with RCA engineers to discuss careers in aerospace engineering.

Voyager Views of the Jovian System

Stunning in numbers, quality and diversity, the thousands of photographs of Jupiter and its satellite planets being transmitted to Earth by Voyager 1 seemingly have shattered many previously held scientific beliefs about the giant of the solar system.





Jupiter

Complex Cloud Formations—The masses of clouds spreading over all of Jupiter (above left) give some hint of the complex motions and circulations in the atmosphere. Voyager 1 time-lapse photography resulted in this and other views of the planet.

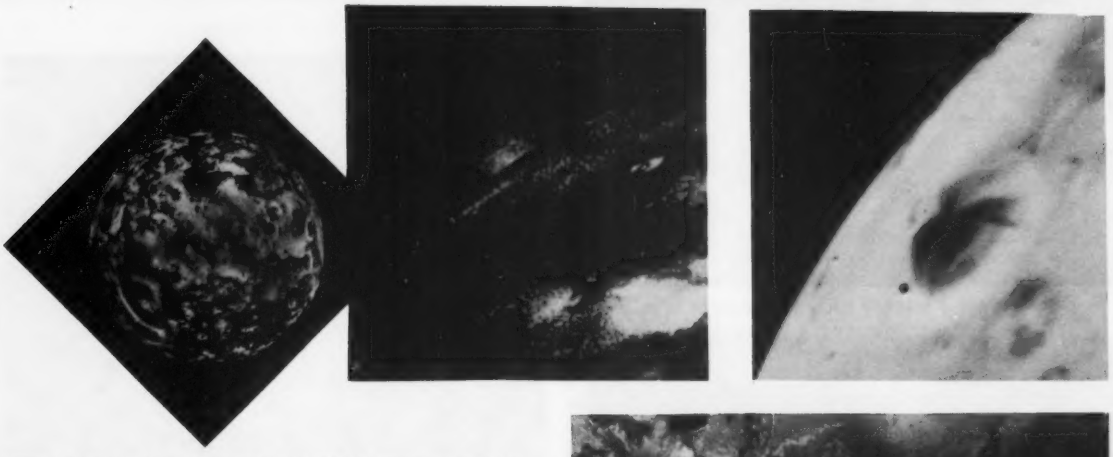
A Ring Encircles Jupiter—First evidence of a flat thin ring of particles around the equator is shown in above right photo (ring has been drawn around planet), created from data seen in photo at immediate right. The band appears as a broad lightband (top left to lower right of photo). Background star trails that look like broken hairpins are caused by spacecraft motion.

Great Red Spot—In mosaic taken March 4 from 1.8 million kilometers away, periphery cloud-streaming characteristics of the counter-clockwise motion of the spot can be seen. Patterns near the center suggest substantially reduced spin.

Io

Satellite Io—Jupiter's innermost major satellite, Io (roughly a third the size of Earth), is tiny when set against the surface of Jupiter and displays features never seen before.

Close-up of Io—Seen in greater detail, Io's surface appears to lack impact features, which suggests a young surface. Mixtures of salts and sulfur may make up most of the surface.

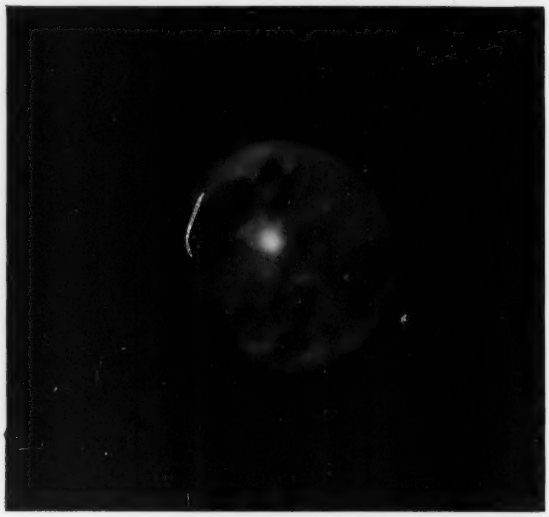


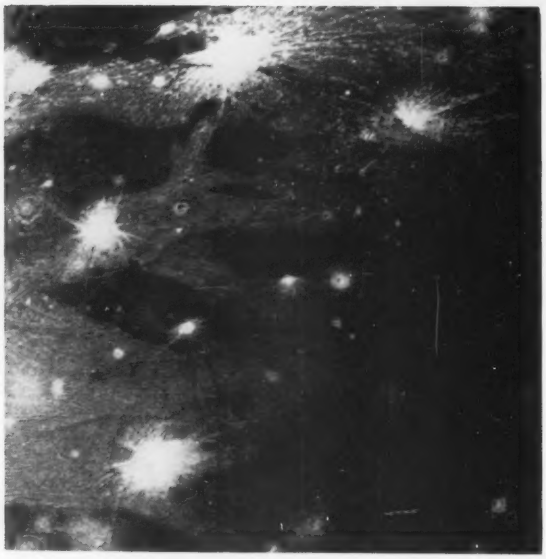
Mosaic of Io—Taken from only 495,000 kilometers from the surface, this photo shows features as small as 10 kilometers wide. Io is about the size of Earth's moon, but its surface appears to have greater diversity.

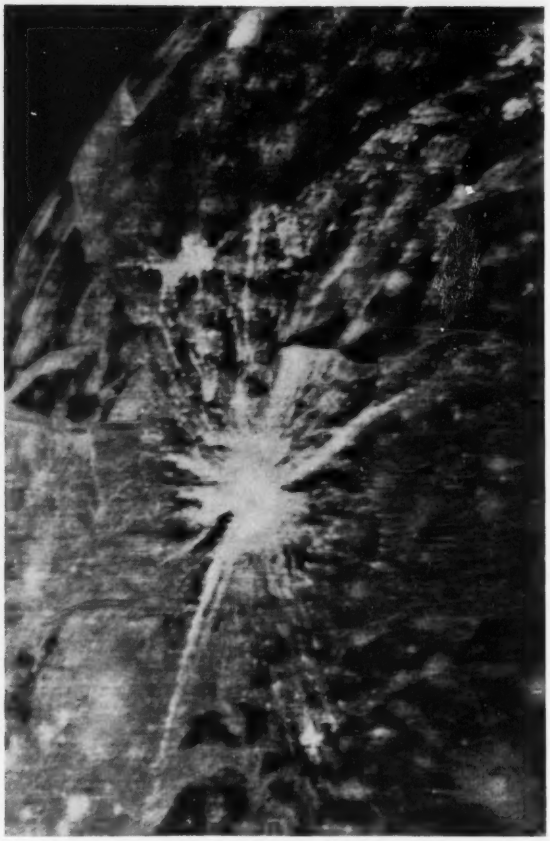
Spectacular Discovery—The first active volcanic eruption—an enormous one—ever seen on a planet other than Earth is visible as a plume against the upper left curve of Io (above middle). It rises about 161 kilometers above the airless surface. Simultaneous eruptions suggest continuous volcanism, which may mean that Io's surface is the most active in the solar system. Another view of the volcano, estimated to have velocities of more than 3200 km/hr, can be seen at upper right. Close-up view (right) of surface shows what may be a volcanic crater with lava flows at bottom of photo. Scientists see the feature as possible evidence that Io, like Earth, is still an active body with a molten interior.

Ganymede

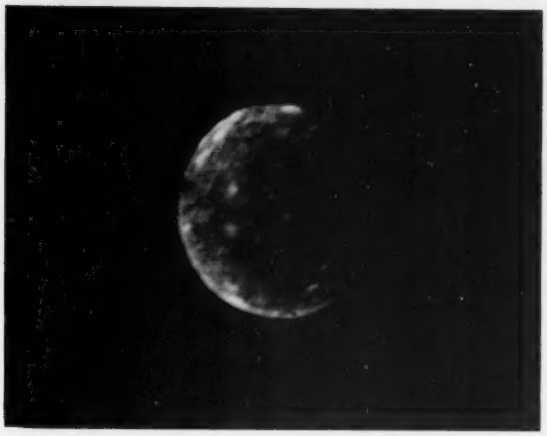
"Moon" Over Jupiter—Jupiter's largest satellite, Ganymede (right), as seen from photo taken by Voyager from a distance of more than eight million kilometers. Ganymede is slightly larger than the planet Mercury, and has a density about twice that of water, leading to the belief that it is composed of rock and ice. Photos of Ganymede surface features (two photos below at left) reveal many bright impact craters with radial patterns of debris ejected by impact of meteors. Because Ganymede's surface is known to contain large amounts of surface ice, scientists interpreting photos believe that bright fresh ice from relatively young craters may account for the white splotches. Large photo at lower right shows a bright, rayed impact crater toward left side of frame. The ejected material extends for 1,000 km. Many older craters are visible that have lost their rays. The three close-up photos were taken at distances of 267,000 to 272,000 km.



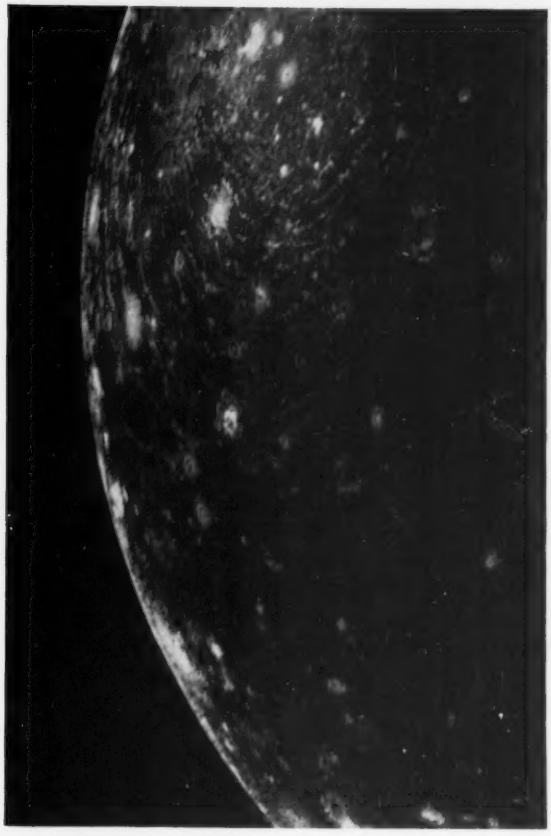




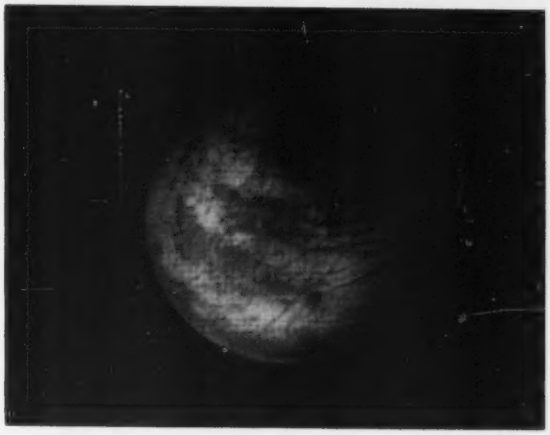
Callisto



Another Jupiter Moon—Callisto, the outermost and darkest of the Jovian satellites, as taken from a distance of about seven million km, is nearly twice as bright as Earth's Moon.



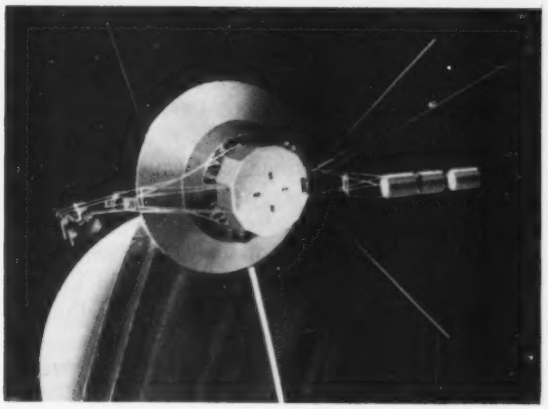
Europa



Another of the Jovian Satellites—Europa, second smallest of Jupiter's five large inner bodies (Amalthea is the smallest), displays surface pattern of dark intersecting lines that may be faults breaking the crust.

Evidence of a Great Collision?—The bullseye pattern (radiating outward from top center of photo at left) may be a large impact basin resulting from collision of a body that nearly penetrated Callisto's crust. Features suggest the surface may be made of water-rich rock, frozen at about 120 K.

The Maker of Miracles—NASA's Voyager 1, the spacecraft that is making it possible for modern science to see clearly much of the solar system for the first time. Set against the enormous planet, Jupiter, Voyager would be such a tiny speck as to be invisible, yet the massive amounts of information it continues to supply are jolting contemporary dogma about the solar system.



DoE Man Joins NASA

Russell Ritchie became Deputy Associate Administrator for External Relations on March 11, 1979. In that position, he will support the Associate Administrator for External Relations in the development of external policy and in the coordination of NASA activities dealing with outside interests.

Ritchie comes to NASA from the Department of Energy, where he served as special project officer to the Undersecretary, specializing in establishing and maintaining effective Congressional, intergovernmental and public relations. Before the DoE was established, Ritchie served in a variety of positions with its predecessor organizations, the Energy Research and Development Administration and the Atomic Energy Commission, where he had major administrative and contract management responsibilities.

From 1960 to 1962 and again from 1965 to 1967, Ritchie served in the U.S. Army Intelligence Corps, including service in Vietnam. He received a B.A. from Washington & Jefferson College in 1960 and attended the Federal Executive Institute in 1974.

New Chief for International Affairs

Kenneth S. Pedersen has been named director of the international affairs division, Office of External Relations. As such, Pedersen is responsible for the management and coordination of NASA's international relations and activities. He replaces Norman E. Terrell, who left NASA to become Deputy Assistant Secretary of Space for Science and Technology.

Pedersen comes to NASA from the Nuclear Regulatory Commission, where his most recent job was director of the Office of Policy Evaluation. His duties there involved advising the Commissioners directly on policies and programs touching all phases of nuclear regulation, including research, inspection and licensing. Pedersen also has worked closely with the International Atomic Energy Agency in Vienna, Austria, where he played a leading role in drafting a code of practice and related safety guides for organizing regulatory agencies in countries embarking on nuclear power programs.

From 1968 to 1971, Pedersen was Assistant Professor of Political Science at San Diego State University, teaching at both the undergraduate and graduate levels and conducting political science research. After leaving the university, he served in various policy analysis positions with the Office of Economic Opportunity, the Department of Commerce, and the Department of Health, Education, and Welfare, before joining the Atomic Energy Commission.

Pedersen was born in Long Beach, Calif. in 1939. He did his undergraduate work at Whittier College, Whittier, Calif., from which he received a B.A. in 1961. In 1965 he was awarded an M.A. degree in International Relations by UCLA. Pedersen was awarded a Fulbright Fellowship in 1966, spending the 1966–1967 year studying in Denmark.

In a related acton, Richard J. H. Barnes has been named deputy director of the international affairs division, replacing Stephen E. Doyle. Doyle transferred to the Office of Technology Assessment, U.S. Congress, as group manager for the telecommunication and information systems group. Since joining NASA in 1961, Barnes has had a variety of assignments in NASA's international affairs and technology utilization programs.

Hinners Leaves NASA

NASA's Associate Administrator for Space Science, Dr. Noel W. Hinners, left the organization recently to become Director of the Smithsonian Institution's National Air and Space Museum in Washington, D.C.

NASA Administrator Dr. Robert A. Frosch said:

"We will all sorely miss Dr. Hinners' extraordinary enthusiasm, technical judgment, and scientific leadership. He is responsible as much as anyone for creating the environment and the programs resulting in such centerpieces of American science as: the High Energy Observatories; the Voyager Saturn mission; the Pioneer-Venus orbiter and probes; the Space Telescope; and the Galileo Jupiter program. He has energized the scientific community both here and abroad, and the past and future accomplishments of that community will for many years owe him a great debt. I am delighted Dr. Hinners has chosen to remain closely

associated with the space fields to which he has already contributed so much, and we expected to be able to continue to rely on his counsel and thoughtful insight."

Hinners joined NASA in 1972 as the deputy director and chief scientist of Apollo lunar exploration, Office of Manned Space Flight, until he was named to his last NASA position on June 26, 1974. He received NASA's Exceptional Scientific Achievement Medal in 1971 and Distinguished Service Medal in 1977.

Before joining NASA, Hinners was associated with Bellcomm, Inc., as a member of the technical staff, supervisor of the lunar science group and head of the Lunar Science Exploration Department.

Hinners was born in Brooklyn, N.Y., Dec. 25, 1935. He received his B.S. degree in Geology and Soil Chemistry from Rutgers University in 1958, M.S. degree in Geochemistry from California Institute of Technology in 1960, and Ph.D in Geochemistry and Geology from Princeton University in 1963.

At Rutgers he graduated with high honors and was elected a member of the Phi Beta Kappa and Sigma Xi honorary societies. He received National Science Foundation Fellowships in 1960–1963. He was the founding editor (1973–1976) of *Geophysical Research Letters,* a new journal of the American Geophysical Union devoted to rapid publication of significant research in earth and space sciences. He is a member of the American Association for the Advancement of Science, the American Geophysical Union, and the Advisory Council, Princeton University, Department of Geological and Geophysical Sciences.

Program Announced for International Meeting

The XXVIIth International Congress of Aviation and Space Medicine will be held Oct. 8 to 12, 1979 at the Philippine International Convention Center in Manila. Suggested topics announced by the organization committee include, but are not limited to: Clinical Aerospace Medicine; Biomedical Aspects of the Aerospace Environment; Flight Safety and Life Support; Research and Training in Aerospace Medicine; Application of Space Technology in Medicine and Biology; Aircraft Accident Investigation and Prevention; Flight Personnel Selection and Examination; Hyperbaric and Underwater Medicine; Space Medicine; and Forensic Medicine Problems in Flying.

Included in the scientific sessions are panel discussions which will be of interest to physicians and surgeons representing various disciplines as well as other medical affiliated persons attending the Congress. Topics under the heading "Consideration of Cardiovascular Diseases" include: neurological disorders; psychiatric disorders; opthalmological and otolaryngological disorders. Other subjects of interest to attendees will include drugs, alcohol and flying; and health control of flying personnel.

Information concerning participation in the Congress and registration materials may be secured from the Secretariat, XXVIIth International Congress of Aviation and Space Medicine, P.O. Box 7675, Airmail Distribution Center, Domestic Airport Road, MIA 3120, Pasay City, Metro Manila, Philippines (Cable Address: AEROSPACE) or from the U.S.A. Secretariat of the Congress: c/o John David Thomas Company, Suite 222, Monadnock Building, 681 Market Street, San Francisco, Calif. 94105.

Minority Firm Gets Contracts—A contract of $766,049 was awarded by the Goddard center to Systems and Applied Science Corp. of Riverdale, Md., to provide technical documentation, editing and related services at the center. Shown at Feb. 9 signing ceremonies are (left, seated) Porter Bankhead, president of the company, and Philip N. Crowley, Goddard contracting officer. Standing are Congresswoman Gladys N. Spellman, Maryland 5th District, and Dr. Robert S. Cooper, Goddard director. The contract with the Small Business Administration (SBA) and the firm has been certified under the SBA 8A program, which covers contracting with economically and socially disadvantaged persons. Goddard finished Fiscal Year 1978 as the NASA center with the highest total dollar figure for contract awards to 8A minority firms. The center leads in 8A awards for all years, both in dollars and number of actions.

Improved Solar Cell Technology

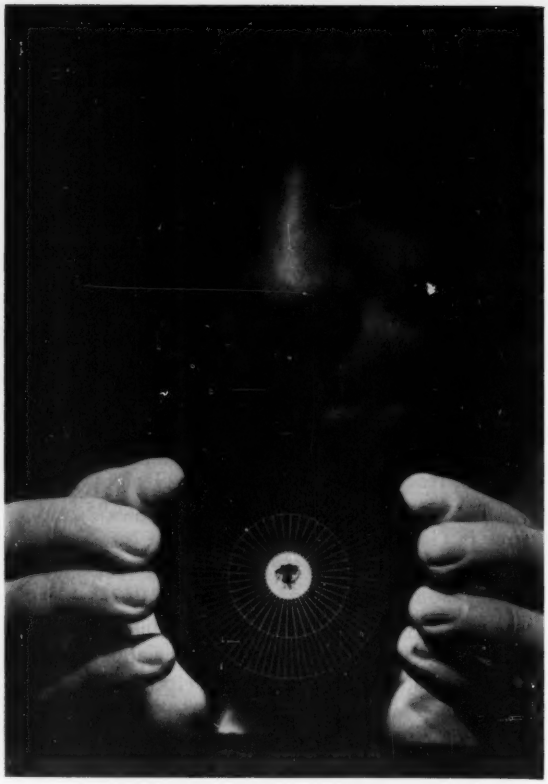
A fabrication technique that may improve solar cell efficiency while increasing the production rate recently was announced by researchers at the Lockheed Missiles & Space Company. Development of the new technique was in conjunction with a Department of Energy program called the Low-cost Solar Array Project, which is managed by NASA's Jet Propulsion Laboratory. The project calls for industry to develop a variety of processes and techniques that could be integrated into an automated assembly line for the mass production of solar cells and modules.

Using a laser to anneal the cells, Lockheed has demonstrated efficiencies of nearly 15 percent. Researchers project that such a development would be a significent step toward attaining high-volume production of photovoltaic cells at costs substantially lower than with existing production methods. Such efficiency levels are higher than those reported by other investigators using laser techniques, researchers report.

Use of high-energy lasers is the key to lower cost and increased efficiency. The laser rapidly anneals the damage in the cell layers that occurs during ion implantation. Implanting controlled amounts of ionized impurities into the thin silicon wafers is necessary to create a junction that produces an electrical current when they are struck by sunlight.

During implantation, the silicon—which acts as structure for the individual solar cell—is bombarded with the impurities that penetrate the surface, leaving considerable damage in their path. In current solar cell production technology, the damage is repaired partially by subjecting the silicon wafers to very high temperatures in a furnace. This furnace annealing technique appears to be inadequate for high-volume production and not cost effective, researchers said. Lockheed scientists have found that laser annealing yields a silicon layer that is considerably less damaged than one that is furnace annealed. Potentially, this can result not only in increased production but also in fewer discarded cells.

Goal of the Low-cost Solar Array Project is to lower the cost from the present $11 a peak Watt to 50 cents a peak Watt. A peak Watt is the amount of electrical power that can be generated when solar cells are exposed to bright sunshine on a summer day, the ideal condition. Potentially, solar energy can generate up to 1,000 peak Watts per square meter of surface.



Low-cost Photovoltaics—Jerry Katzeff, Lockheed researcher, holds a 7.62 centimeter cell used in the Low-cost Solar Array project study sponsored by the federal Department of Energy and administered by NASA's Jet Propulsion Laboratory.

Toastmasters Milestone

The first continent-spanning joint Toastmasters meeting was conducted in January, courtesy of the U.S./Canadian Communications Technology Satellite (CTS). Participants were the NASA Toastmasters Club at headquarters, and Ames Research Center members of the Jetstream Toastmasters Club at Moffett Naval Air Station, Calif. The satellite provided duplex television to link the clubs together

The meeting was carried out as part of a NASA experiment to evaluate the effectiveness of video-conferences as a time-and travel-saving alternative for business conferences. Other participants in the meeting were members of the Federal Aviation Administration Speechmasters Club. Distinguished guests at headquarters included Dr. Harriett Jenkins, Director of the NASA Office of Equal Opportunity

Programs, and Toshio Hoshide, District Governor of Toastmasters National Capital District. They were enthusiastic about the use of satellite communications to permit such widely separated groups to assemble for a common purpose.

The meeting was conducted using the usual Toastmasters format but with program responsibilities and participation divided between the two locations. Control of the meeting was passed between the two locations with television monitors at both locations permitting interaction between the participants and their audience. The meeting was called to order by Inez Williams at headquarters and the invocation was delivered by Alfonso Ludi. The presiding officer, Otis Langford, a National Capital District Lt. Governor, introduced the Toastmaster of the Day, Guy Ferry, a former Toastmasters International Director, at Ames. Ferry then introduced the "Table Topics" conductors at each location, Rondal Crawford at headquarters and Ernest Iufer at Ames, who called on participants for spontaneous two-minute speeches. Ferry introduced the prepared speakers at both locations. The speakers at headquarters were June Sanders (voted best speechmaker of the day) and Patricia Romanofsky (FAA); the speakers at Ames were Millard Edgerton and Thomas Shea.

Toastmaster training requires prepared speakers to be evaluated on how well they met the objectives of their speech. These evaluations were provided at Ames by Ruben Ramos for June Sanders and Miles Murphy for Patricia Romanofsky. At headquarters Marc Aucremanne and Ken Geisinger (FAA) provided evaluations for Edgerton and Shea. A final general evaluation of the meeting was provided by Joe Turtil at headquarters, who praised the group for its usage of the unfamiliar communications medium.

The NASA Toastmasters and Jetstream clubs are chartered by Toastmasters International, a non-profit, educational organization with headquarters in Santa Ana, Calif. There are presently more than 65,000 Toastmasters in 3,200 clubs in 41 countries. Some 135 clubs with over 2,700 members are established in the National Capital District, with more than half in government agencies. In addition to the headquarters and Ames groups, NASA clubs have been formed at Goddard, Kennedy and the Jet Propulsion Laboratory. Marshall employees belong to a club at Redstone Arsenal, Langley employees belong to a club at Hampton, Va. and White Sands employees belong to a club at Las Cruces, N.M.

Toastmasters Linked Coast-to-coast by Satellite—Watching Ernest Jufer (Ames) on top TV screen, Marcel Aucremanne of NASA headquarters on bottom screen, are (l. to r.) George Yip, Toastmaster Area Governor (standing); Patricia McGrath and John Manning of NASA headquarters (seated in back row); (seated in front row) Michelle Addison of NASA headquarters; Patricia Romanofsky of FAA; Toshio Hoshide, Toastmaster District Governor; and Don Miller, Toastmaster District Bulletin Editor.

Black Group Praises JSC for Minority Effort

Recognition for the positive steps the Johnson Space Center has taken in increasing opportunities for minority employees came in the form of the Progressive Opportunity Award, given for the first time by the Houston Citizens Chamber of Commerce at their 43rd annual meeting at the Houston Club last January.

Astronaut candidate Guion S. Bluford accepted the award on behalf of JSC for center director Christopher Kraft.

The center was recognized for its role as the leading federal agency in the Houston area in recruitment, employment, promotion and career development of minority professional—scientists, engineers, and administrative personnel—and for the 1978 astronaut recruiting program, which included the first minority astronauts.

Organized in 1935, the Houston Citizens' Chamber of Commerce is a voluntary organization of business and professional men and women representing the black community in Houston.

American Rocketry Leader Dies

Robert B. Young, 61, engineering vice president of Aerojet-General Corp. and one of America's leading rocket propulsion engineers, died last Feb. 7.

The Los Angeles-born Young played a leadership role in development of many of the nation's rocket propulsion systems including those for the Air Force Titan rocket and the Apollo spacecraft main engine, which put astronauts in orbit around the Moon and powered their homeward flight.

In the early 1960s Young took a leave of absence from Aerojet to join NASA as a key associate of Dr. Wernher von Braun in development of engines for the Saturn rocket.

A California Institute of Technology graduate who joined Aerojet 36 years ago, Young held many technical and executive leadership positions associated with rocketry from the earliest days of JATO (Jet Assist Takeoff Rockets) through Aerobee scientific sounding rockets, the Gemini manned space flight booster and the Nerva nuclear rocket. At the time of his death, he was corporate vice president of engineering and quality assurance, for Aerojet.

Young was honored with the Propulsion Award by the American Rocket Society in 1961 and in 1966 was elected a Fellow of the American Institute of Aeronautics and Astronautics. He received the Air Force Association (California Wing) Scientific Achievement award for 1959–60.

Young was a graduate of Hollywood High School and received his bachelor of science degree from CalTech in 1940. He is survived by his wife, Ann, three children—Patricia, Robert, Jr. and Deborah Ann—and two grandchildren.

Contractor News

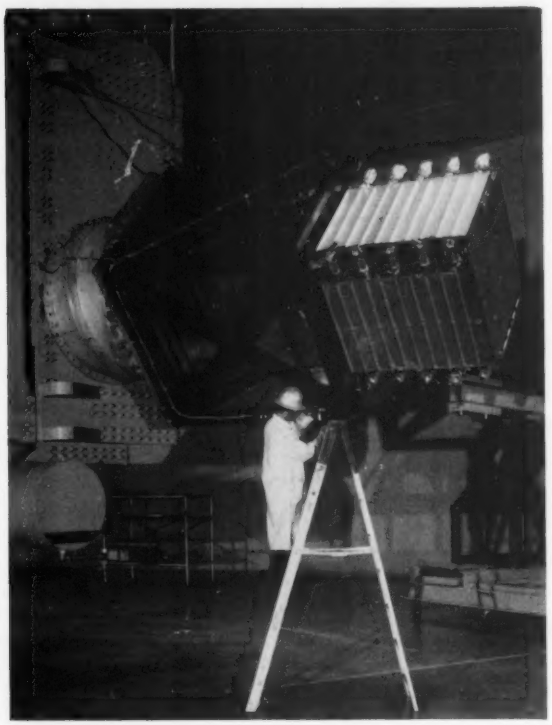
In one of the largest agreements in NASA's history, **Rockwell International Corp.,** Space Systems Group was awarded a $1.9 billion contract to build two new Space Shuttle orbiters and refurbish two others. It was the first contract to be negotiated and awarded under terms of the President's wage-price guidelines. The California-based firm will complete all work by late 1983. Under terms of the cost-plus-award fee contract, Rockwell will perform the work at its Downey and Palmdale facilities and at the Kennedy center. The Johnson center will administer the contract.

Western Union Space Communication, Inc. has received a modification of a NASA contract to provide telecommunication services via the Tracking and Data Relay Satellite System for support of Earth-orbital space operations. Value of the contract modifications is about $80 million. Total value of the 10-year contract to the Western Unon Corporation-owned subsidiary is $866 million plus award fee. The readiness date for the launch of the first TDRSS spacecraft is delayed until December 1980 to incorporate the modifications. Full commercial service via the Advanced Westar part of the TDRSS is postponed until the fourth spacecraft is launched. The TDRSS constellation will consist of four specialized communications in synchronous Earth orbits and a ground terminal at White Sands, N.M.

High's Carpet Care and Janitorial Service, Inc., (Hampton, Va.), has been awarded a contract to provide custodial services for the Langley center. The contract is one of the largest ever awarded by Langley to a minority-owned small business. The value of the three-year agreement is estimated at about $2.4 million. High's will provide cleaning service for all offices, laboratories, shops, warehouses, restrooms, floors, stairways, and elevators at Langley. The contractor also will remove snow and ice from exterior steps, building entrances and walkways, and set up furniture and equipment for Langley conference rooms. The incentive contract became effective Feb. 1 and will run through early 1982.

Launches for 1979

Name	Launch Date	Vehicle	Range	Mission Remarks
SCATHA	Jan. 30	Delta	ETR	DoD R&D. Spacecraft charging at high altitude Reimbursable.
SAGE-A	Feb. 18	Scout	WFC	NASA applications satellite. Stratospheric aerosol and gas experiment.
Navy-20, C/U	April	Scout	WTR	DoD Transit. Reimbursable.
FLTSATCOM-B	May 3	Atlas Centaur	ETR	DoD Navy communication satellite. Reimbursable.
NOAA-A	May 16	Atlas-F	WTR	NOAA weather satellite. Reimbursable.
UK-6	May 24	Scout	WFC	UK scientific satellite. Reimbursable.
Westar-C, C/U	August	Delta	ETR	Western Union communications satellite. Reimbursable.
Intelsat V-A	August	Atlas Centaur	ETR	Intelsat communications satellite. Reimbursable.
HEAO-C	September	Atlas Centaur	ETR	Third high energy astronomical observatory to study highly energetic radiation from space.
MAGSAT-A	September	Scout	WTR	NASA applications satellite to study magnetic field.
Navy-21	October	Scout	WTR	DoD transit satellite. Reimbursable.
SMM-A	October	Delta	ETR	NASA solar maximum mission satellite.
Space Shuttle	Nov. 9	Space Shuttle	ETR	First manned Shuttle orbital flight.
RCA-C	December	Delta	ETR	Domestic communications satellite. Reimbursable.



Shuttle Control System—This is a heat pipe thermal control control system slated for test aboard an early orbital test flight of the Shuttle as it is prepared for testing at the Goddard center. During tests, the system was subjected to increased gravity pull by means of a rotating centrifuge to simulate launch conditions of the Shuttle. The test payload eventually will be used for thermal control of scientific instruments mounted on the Shuttle payload bay.

Patents for Inventions from NASA Research

The Office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

Inventor(s) and Employer	Title	Patent No.	Installation
Edward A. Enriquez, Hughes Aircraft Ronald E. Gookin	System for syncronization synthesizers of communication systems	4,140,972	GSFC
Leipold A. Hein, MFSC William N. Myers	Apparatus for concentrating solar energy	4,139,286	MFSC
Shakkottai P. Parthasarathy, JPL	System and method for obtaining wide screen schlieren photographs	4,139,291	NRLO
Hilda Kanber, JPL	Acoustic driving of rotor	4,139,806	NRLO
Alexander Engel, Oakland Univ.	Digital data reformatter deserializer	4,139,839	NRLO
Richard E. Haskell, JPL	Interactive color display for multispecra imagery using correlation clustering	4,139,862	MSFC
David Elliott, JPL	Method and turbine for extraction kinetic energy from a stream of two-phase fluid	4,141,219	NRLO
Jessee M. Madey, GSFC	Rotary electric device	4,142,119	GSFC
Lo I. Yin, GSFC	Low intensity X-ray and gamma-ray imaging device	4,141,101	GSFC
Walter Appleberry, Rockwell Intl. Space Div., Downey, Calif.	Sequencing device utilizing planetary gear set	4,141,259	MSFC
Donald L. Alger, LERC William B. Schwab Edward R. Furman	Closed loop spray cooling apparatus	4,141,224	LeRC

Leading the Way—During the first Space Shuttle launch, this nose cap spike will be built onto the forward tip of ET–1, the first flight external tank. The cone-shaped spikes are manufactured in Huntsville by Medtherm Corp. for the Martin Marietta Corp., prime contractor to the Marshall center for the Shuttle external tank. At left is Larry Jones, president of the Huntsville firm, presenting the flight article to Jim Hudson, Martin Marietta representative at Marshall. The two-piece spike is the sensing portion for the ascent air data system. It also functions as a lightning rod.

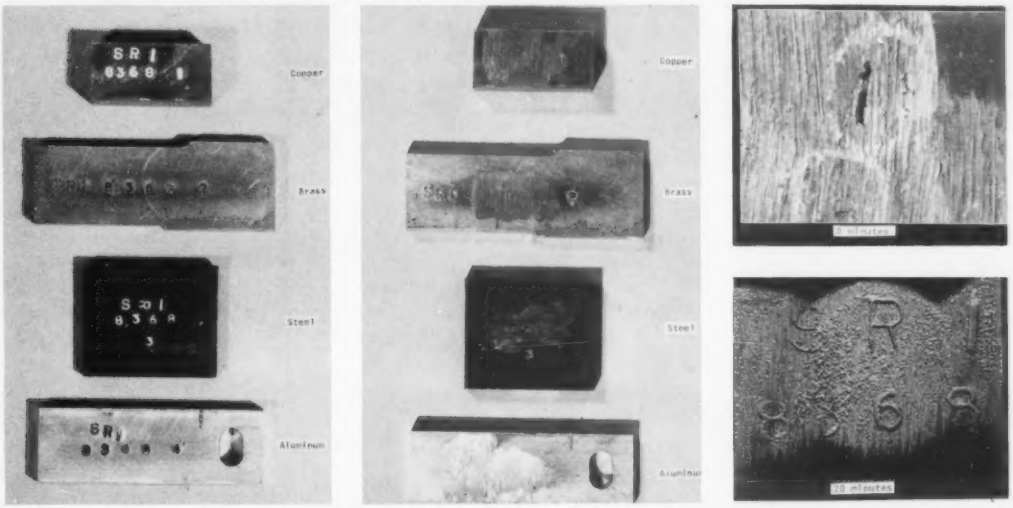
. . . *Continued from Another Dividend*

ferred by a research grant to investigators at Chicago State University, a predominantly minority (black) school. Coordinator of the entire effort was Lewis engineer Harrison Allen, Jr., of the Technology Utilization unit. The new research team studied the effect of various experimental conditions on restoration effectiveness and determined recoverability limits.

To establish the merits of the NASA ultrasonic restoration technique, it was necessary to compare it to the conventional methods of etching—chemical, magnetic, electrolytic, heat treatment, and so on. By so doing, the Chicago State University research expanded the knowledge of all serial number restoration techniques as well as the NASA ultrasonic method, through the use of controlled experiments. Before that work, no universal and comprehensive publication on the subject had existed for the use of crime laboratories. Because the need for such a guide was clear, the Chicago State University research work was published in the form of a handbook which filled the void.

Due in part to the grant and the interest it stimulated in forensic science, the Department of Physical Sciences at Chicago State University now offers a Bachelor of Science degree in Chemistry with a Forensic Science Option.

Beginning Restoration of Firearm ID—A Chicago State University student begins the process that will eventually reestablish missing serial numbers on a handgun.



How Serial Numbers Are Restored—First photo shows original steel and copper specimens with numbers intact; second photo was taken after digits had been obliterated; third photo shows closeup of specimen at beginning of restoration process and 20 minutes later when numbers have been almost completely restored.

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

Restoring Obliterated Serial Numbers

The forensic science community has often been the beneficiary of aid from NASA-innovated and supported technology. That technology helped to solve a problem that often plagues crime laboratory technicians, namely the need to restore to visibility serial numbers that have been to all intents and purposes obliterated from a metal object. Perhaps the object is a gun found at the scene of a crime with its serial number filed off by the criminal to prevent law enforcement officers from tracing its ownership. Or the evidence under study might be a stolen bicycle with the number removed to prevent proper identification.

For the last 40 years, various restoration methods have been reported in criminal science literature. Most often, a chemical etching technique has been employed. Now, as a result of a discovery by NASA engineers, the etching and recovery can be accomplished without using corrosive chemicals. Highly energized water vapor bubbles are used instead.

When water or other liquids are placed in a state of ultrasonic (rapid) vibration, a phenomenon known as cavitation can occur. Cavitation is the formation of tiny vapor bubbles in the liquid. It is a process similar to boiling except that the driving force is the energy from vibrations rather than heat. Because the vapor bubbles contain high energy, they etch the surface of a metal when they collapse on or near it. Because cavitation leads to deterioration of tubes, pumps and valves carrying high velocity liquids, it is a problem for designers of space vehicles and power systems. Therefore, to *prevent* cavitation damage, NASA engineers had to become experts in understanding the phenomenon. In the course of their study, those designers asked the obvious question: Can the etching effect of ultrasonic cavitation be used in any beneficial way?

NASA engineers from the Lewis Research Center determined that ultasonic cavitation etching could be used as a metallographic analysis technique, after which NASA issued a publication on the general topic and the Stanford Research Institute suggested that NASA investigate the application of ultrasonic cavitation to the restoration of obliterated serial numbers on metal. Some of the early testing was done with items supplied by the Cleveland Police Department and the National Auto Theft Bureau. Initial results proved successful.

To accomplish a restoration, the specimen is immersed in water and a vibration probe, called the "horn," is positioned a short distance above it. Inside the probe, electrical energy is converted into ultrasonic vibrating energy by a piezoelectric transducer. The ultrasonic vibrations of the probe induce cavitation in the water. As the bubbles hit the metal surface, they pit it. Recovery of the number is accomplished because the visual nature of the pitting is different immediately below the stamped indentation than elsewhere.

After NASA demonstrated the feasibility of the technique, the task of improving it was trans-

Continued on page 27 . . .

For the benefit of all . . .

NASA
National Aeronautics and Space Administration

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